UPPSALA ASTRONOMISKA OBSERVATORIUM

Meddelande N:o 120

A PHOTOMETRIC AND STATISTICAL INVESTIGATION INTO STARS IN BRIGHT AND DARK REGIONS IN AURIGA

By

OLOF EKLÖF

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ALMQVIST & WIKSELLS BOKTRYCKERI AB

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INAUGURAL DISSERTATION

BY

OLOF EKLÖF
FIL. LIC., G.-H.

BY DUE PERMISSION OF THE FACULTY OF
SCIENCE OF THE UNIVERSITY OF UPPSALA.
TO BE PUBLICLY DISCUSSED IN LECTURE ROOM IV,
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The present paper is a summary of three earlier ones by the writer, as follows:

A. Blue and red magnitudes in the Auriga region. I. Preliminary note. Arkiv för astronomi, 1, No. 8 = Uppsala Medd., No. 98, 1949.

B. Blue and red magnitudes in the Auriga region. II. The observations and the Catalogue. Arkiv för astronomi, 1, No. 27 = Uppsala Medd., No. 106, 1954.

C. A statistical investigation into the dark nebulae in Auriga. Arkiv för astronomi, 2, No. 21 = Uppsala Medd., No. 119, 1958.

In what follows these papers will be referred to as Papers A, B, and C.

Introduction

Investigations into the light absorption in space caused by interstellar matter are of great importance for our knowledge about the structure of our Galaxy. The distances to remote stars, determined by photometric methods, may be strongly falsified if we are not acquainted with the properties of interstellar absorption.

We can speak about absorption in two different meanings. *The total absorption* gives a measure of the total loss of light at a certain wave-length, whereas *the selective absorption* is defined as the difference between the total absorptions at two different wave-lengths. The direct determination of the total absorption is a difficult undertaking—at least if we want to know how great the absorption is in the light of an individual star. On the contrary, the selective absorption can easily be obtained by means of the colour indices of the stars, the only conditions for this being that we know the spectral types of the stars and the normal colour attributed to each class. Then we can study the selective absorption as a *colour excess*, which is defined as the difference between the observed colour and the normal one. Of course, both colours must be expressed in the same colour system.

Several investigations have shown that the ratio between the total absorption and the colour excess is constant, at least if we restrict ourselves to small regions in the sky. Therefore, if by means of colour determinations we obtain the colour excesses of the stars in a region, we can be informed about the total absorption in the same region provided that it is possible to determine a value of the ratio mentioned. When interpreting the results of the observations, we must apply the methods of stellar statistics.

The present investigation deals with the determination of the selective and total absorption in a region of Auriga, situated at the galactic longitude of 135° and extending perpendicularly to the galactic equator from $-7\overset{\circ}{.}5$ to $+7\overset{\circ}{.}5$, the breadth of the region being on an average 5°. In the following lines there is a short summary of the results of the investigation.

The determination of magnitudes and colours

The investigation is founded on the determination of blue and red magnitudes in Auriga. The observations were made with the Schmidt–Väisälä telescope of the Uppsala Observatory. As standard systems H. Haffner's and O. Heck-

mann's (1937) blue and red magnitudes of stars in Praesepe were used. A control of the colour system was made by means of photo-electric colour determinations.

The observations are described in detail in Paper B. They were arranged so as to avoid, as far as possible, various sources of error. The influence of pre- and post-exposure was eliminated by photographing Praesepe and Auriga on different parts of the plate, one half of the plate being covered when the other was exposed. Errors deriving from the atmospheric extinction were, as far as possible, avoided by observing Praesepe and Auriga at the same altitudes. The influence of the varying sensitivity of the photographic film of the plates was diminished by always exposing blue and red images close to each other on the same plate. In order to determine the magnitudes of the brightest stars in Auriga, exposures were made through an objective grating. The magnitude difference between exposures with and without the grating was used for the construction of reduction curves. Special attention was devoted to the difficulty of avoiding systematic errors when this method is used.

As a result of the observations, Paper B contains a Catalogue giving blue and red magnitudes and blue-red colour indices of about 1800 stars. The Catalogue also records the spectral types of about 1200 stars according to the investigations by C. Schalén (1928, 1932). The mean error of one determination of a blue or red magnitude is about ± 0.08 mag. in the middle magnitude intervals. The mean error in one determination of a colour index is about ± 0.09 in the same magnitude intervals. The correspondent mean errors in a catalogue value are ± 0.045 and ± 0.050 mag., respectively.

The statistical investigations

In the beginning of Paper C there is an account of the determination of blue-red normal colours. They were obtained from near-by stars in the bright parts of the region. Table 2 of this paper gives a list of the values adopted.

By using the normal colours the excesses of the stars were calculated. Then, by means of the excesses, the field was divided into bright and dark regions. The excess diagrams of the different regions were constructed, indicating the presence of discrete dark nebulae.

The determination of ratio R between total blue absorption and blue-red colour excess gave the result $R = 2.7$. Three different methods were used.

The last problem was to derive the total absorption as a function of the distance. According to the methods developed by K. G. Malmquist (1943, 1945), theoretical excess curves were computed. The distances of the nebulae were

varied until the computed excess curves coincided with those observed. As a result it was found that the absorption in the region investigated was caused by nebulae at about the distances 125, 300 and 600 pcs. Comparisons with earlier determinations of the distances to the nebulae in Auriga show better agreement with the investigations founded on colour indices than with those based on star counts.

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The Observatory, Uppsala, March 1958.

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